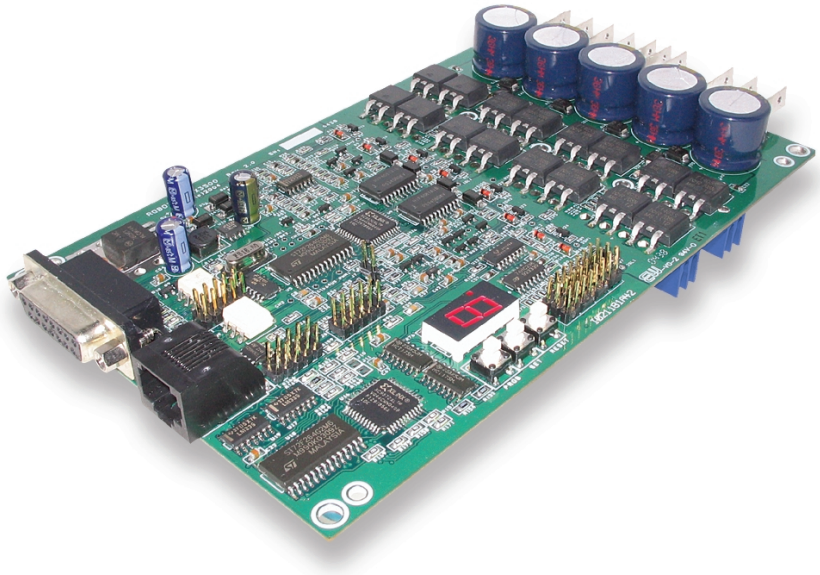
RoboteQ

AX3500

Dual Channel High Power Digital Motor Controller

Quick Start Manual



v1.7, February 1, 2005

visit www.roboteq.com to download the latest revision of this manual

©Copyright 2003-2005 Roboteq, Inc.

SECTION 1

AX3500 Quick Start

This section will give you the basic information needed to quickly install, setup and run your AX3500 controller in a minimal configuration.

Important Safety Warnings

The AX3500 is a high power electronics device. Serious damage, including fire, may occur to the unit, motors, wiring and batteries as a result of its misuse. Transistors may explode and require the use of safety glasses when operated in direct view. Please review the User's Manual for added precautions prior to applying full battery or full load power.

This product is intended for use with rechargeable batteries.

Unless special precautions are taken, damage to the controller and/or power supply may occur if operated with a power supply alone. See"Power Regeneration Considerations" on page 31 of the Users Manual.

What you will need

For a minimal installation, gather the following components

- One AX3500 Controller and its provided cables
- 12V to 40V high capacity, high current battery
- One or two brushed DC motors
- One R/C to DB15 connector (provided)
- Miscellaneous wires, connectors, fuses and switch

Locating Switches and Connectors

Take a moment to familiarize yourself with the controller's switches and connector.

The front side (shown in Figure 1) contains the buttons and display needed to operate and monitor the controller. The 15-pin connector provides the connection to the R/C or micro-computer, as well as connections to optional switches and sensors.

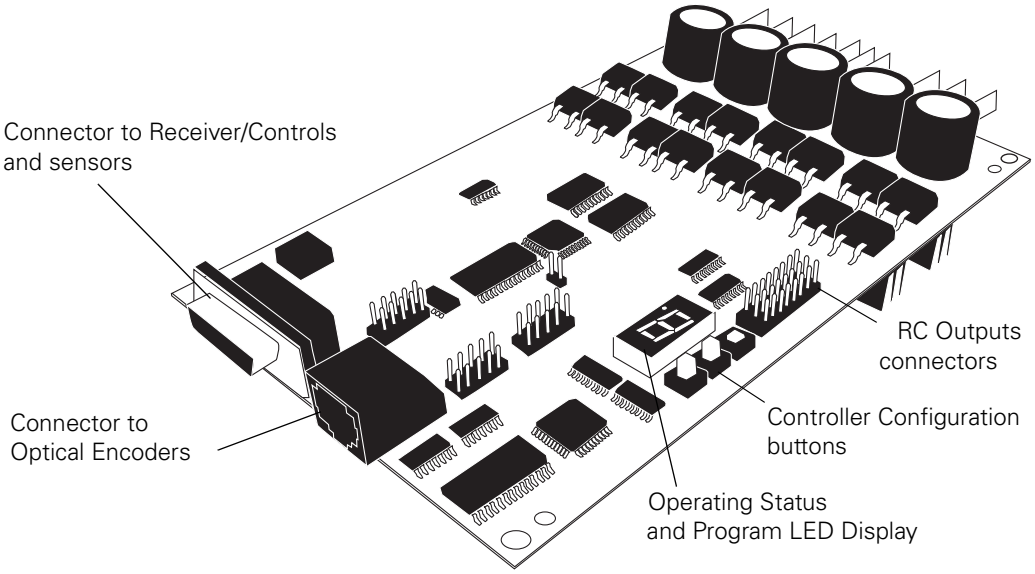

Connector to Receiver/Controls and sensors
RC Outputs connectors
Connector to Optical Encoders
Controller Configuration buttons
Operating Status and Program LED Display

FIGURE 1. Controller Front View

At the back of the controller (shown in the figure below) are located all the Fast-on tabs that must be connected to the batteries and the motors.

Note:
Both VMot tabs are connected to each other in the board and must be wired to the same voltage.

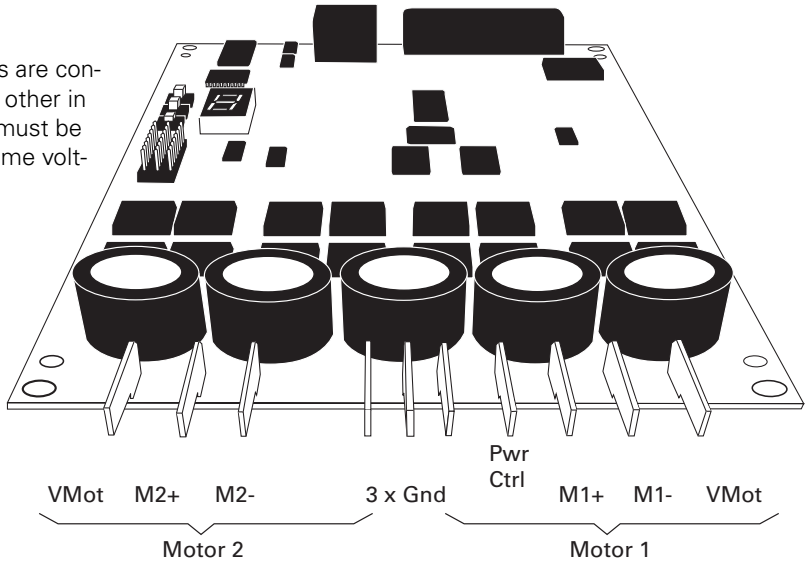
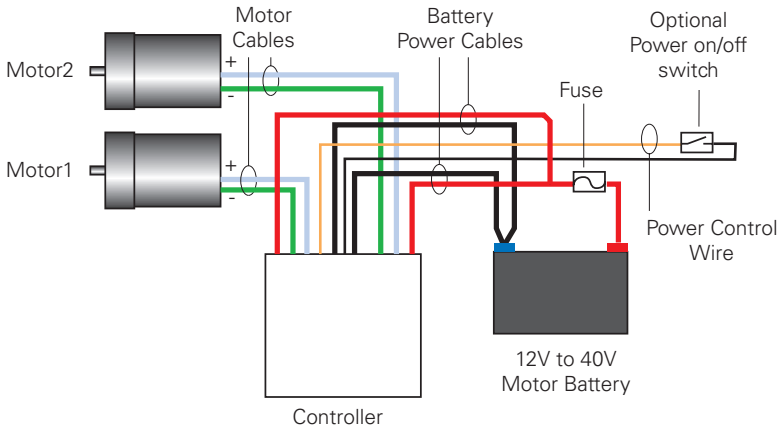


FIGURE 2. Controller Rear View

Connecting to the Batteries and Motors

Connection to the batteries and motors is shown in the figure below and is done by connecting wires to the Fast-on tabs on the controller.



Notes:

- The Battery Power connection are doubled in order to provide the maximum current to the controller. If only one motor is used, only one set of motor power cables needs to be connected
- Typically, 1, 2 or 3 x 12V batteries are connected in series to reach 12, 24 or 36V respectively
- The Power Control wire may be used to turn On and Off the controller, or to provide a separate and stable supply to the controller's logic (See discussion below)

FIGURE 3. Electrical Power Wiring Diagram

1- Connect two of the three Ground tabsto the minus (-) terminal of the battery that will be used to power the motors. Connect the two VMot tabsto the plus (+) terminal of the battery. The motor battery may be of 12 to 40 Volts. There is no need to insert a switch on Motor Power cables, although one is suggested.

The two VMot tabs are connected to each other inside the controller. The same is true for the Ground tabs. You should wire each pair together as shown in the diagram above.

2- You may leave the Power control tab unconnected, or you may connect it to a power switch.

Refer to the chapter "Connecting Power and Motors to the Controller" on page 25 for more information about batteries and other connection options.

3- Connect each motor to one of the two output tabs pair. Make sure to respect the polarity, otherwise the motor(s) may spin in the opposite direction than expected

Important Warning

The controller includes large capacitors. When connecting the Motor Power Cables, a spark will be generated at the connection point. This is a normal occurrence and should be expected.

Using the Power Control Tab

The AX3500 includes a DC/DC converter that will generate a 12V internal supply from the main +12 to +40V battery. As a result, the controller will turn On as soon as the Vmot and Ground tabs are connected to the battery.

In order to turn On and Off the controller without the need for a bulky and expensive switch or relay on the high current wires, the AX3500 uses a Power Control input to enable or disable the internal DC/DC converter. When left unconnected, the DC/DC converter is On. When grounded, the DC/DC converter is Off.

The Power Control tab can also be used to feed a separate supply to the controller so that it will continue to operate if and when the main batteries' voltage dips below 12V. The table below shows the various functions of the Power Control input. See "Connecting Power" on page 25 for more details on the use and operation of the Power Control signal.

TABLE 1. Use of Power Control wire

Power Control input connected to	**Action**
Floating	Controller is On
Ground	Controller is Off
Separate 12V to 40V supply	Controller is On. Controller will draw power from the Power Control tab if main battery voltage dips below 12V.

Connecting the R/C Radio

Connect the R/C adapter cables to the controller on one side and to two or three channels on the R/C receiver on the other side. The third channel is for activating the accessory outputs and is optional. Note: the channel 3 RC input is not yet implemented in the AX3500.

When operating the controller in "Separate" mode, the wire labelled Ch1 controls Motor1, and the wire labelled Ch2 controls Motor2.

When operating the controller in "Mixed" mode, Ch1 is used to set the robot's speed and direction, while Ch2 is used for steering.

See "R/C Operation" on page 69 of the User's Manual for a more complete discussion on R/C commands, calibration and other options.

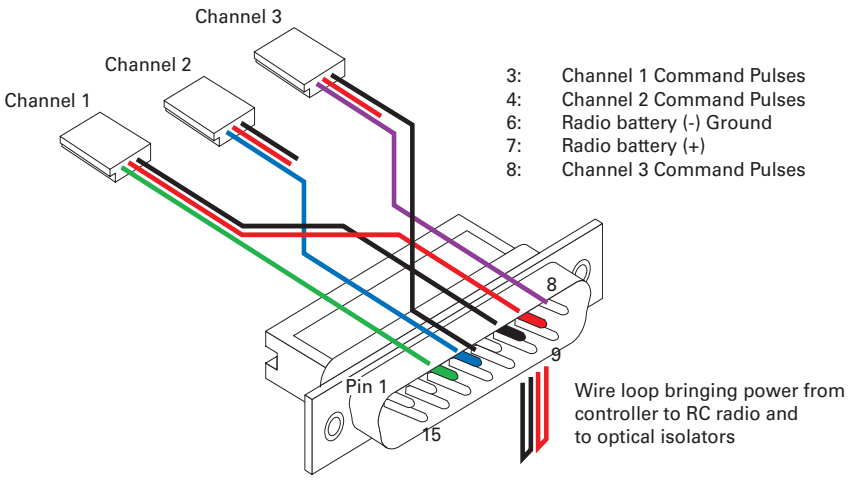


FIGURE 4. R/C connector wiring for 3 channels and battery elimination (BEC)

This wiring - with the wire loop uncut - assumes hat the R/C radio will be powered by the AX3500 controller. Other wiring options are described in "R/C Operation" on page 69 of the User's Manual.

Important Warning

Do not connect a battery to the radio when the wire loop is uncut. The RC battery voltage will flow directly into the controller and cause permanent damage if its voltage is higher than 5.5V.

Powering On the Controller

Important reminder: There is no On-Off switch on the controller. You must insert a switch on the controller's power tab as described in section "Connecting to the Batteries and Motors" on page 13.

To power the controller, center the joystick and trims on the R/C transmitter. Then turn on the switch that you have placed on the Battery Power wire or on the Power Control wire.

If the R/C transmitter and/or receiver is powered off, the display on the controller will alternate the letters spelling "no ctrl" to indicate that it is On but is not receiving a control signal.

FIGURE 5. "no control" scroll message indicates no valid R/C signal is present

Turn the R/C transmitter On. The "no ctrl" scrolling message will disappear and the display will show steady patterns depending on the motors' selected direction.

Move the joystick on the transmitter to activate the motors to the desired speed and direction.

See "R/C Operation" on page 69 of the User's Manual for a detailed description of the many features and options available in the R/C mode.

Button Operation

The AX3500 has three buttons: **Set**, **Program** and **Reset**. These buttons are not needed for normal operation, as the controller is immediately operational upon power up.

The **Reset** button will restart the controller. This button is recessed and you will need a paper clip to press it. Reset is also accomplished by turning the controller's power Off and back On.

The **Set** and **Program** buttons have the following functions depending how and when they are pressed:

TABLE 2. AX3500 Buttons Function

Prog and Set button status	**Function**
Press and hold **Program** alone during reset or power up	Enter the Programming Mode.
Press and hold **Set** alone during reset of power up	Enter Self-Test mode. See "Self-Test Mode" on page 47 of the User's Manual
Press and hold **Program** and **Set** together during reset or power up	Reset configuration parameters to factory default
Press **Program** while Programming Mode	Accept previous parameter change and select next parameter
Press **Set** while in Programming mode	Change value of selected parameter
Press **Program** pressed alone during normal operation	No effect
Press **Set** alone during normal operation	No effect
Press **Program** and **Set** together during normal operation	Emergency stop

Default Controller Configuration

Version 1.7 of the AX3500 software is configured with the factory defaults shown in the table below. Although Roboteq strives to keep the same parameters and values from one version to the next, changes may occur from one revision to the next. Make sure that you have the matching manual and software versions. These may be retrieved from the Roboteq web site. See "Configuring the Controller using the Switches" on page 159 of the User Manual for a complete configuration parameter list and their possible values.

TABLE 3. AX3500 Default Settings

Parameter	Default Values	Letter
Input Command mode:	(0) = R/C Radio mode	I
Motor Control mode	(0) = Separate A, B, speed control, open loop	C
Amp limit	(5) = 52.5A	A
Acceleration	(2) = medium-slow	S
Input switch function	(3) = no action	U
Brake/Coast	(0) = brake when idle	b
Joystick Deadband	(2) = 16%	d
Exponentiation on channel 1	(0) = Linear (no exponentiation)	E
Exponentiation on channel 2	(0) = Linear (no exponentiation)	F
Left / Right Adjust	(7) = no adjustment	L

Checking and Changing Configurations

Any one of the parameters listed in Table 3, and others not listed, can easily be changed either using the controller's buttons or your PC with the Roboteq Configuration Utility.

The example below shows how to use the buttons to select and change the Motor Control mode from "separate" to "mixed". See "Configuring the Controller using the Switches" on page 159 of the User's Manual for a complete list of all the AX3500's parameters and their meanings.

Restart
Press & hold **Prog** ▶

Press and hold the **Prog** button for 10 seconds while resetting or powering on the controller

Program mode entered
after 10 seconds ▶

After 10 seconds, the controller will enter the programming mode and flash alternatively the current parameter (I= Input Mode) and its value (0= R/C mode).

Press **Prog** to select next parameter

Press the **Prog** button to move to the next parameter (C= Motor Control Mode) and its value (0= Separate)

Press **Set** to select next value for parameter

Press the **Set** button to change the parameter's value (1= Combined)

Press **Prog** to store change and select next parameter

Reset controller to exit

Press the **Prog** button record the change and move to the next parameter (A= Amps limit) and it's value (2= 75A)

Press the **Reset** button or power off/on the control to restart the controller using the new parameters.

Connecting the controller to your PC using Roborun

Connecting the controller to your PC is not necessary for basic R/C operation. However, it is a very simple procedure that is useful for the following purposes:

- to Read and Set the programmable parameters with a user-friendly graphical interface
- to obtain the controller's software revision and date
- to send precise commands to the motors
- to read and plot real-time current consumption value
- Save captured parameters onto disk for later analysis
- to update the controller's software

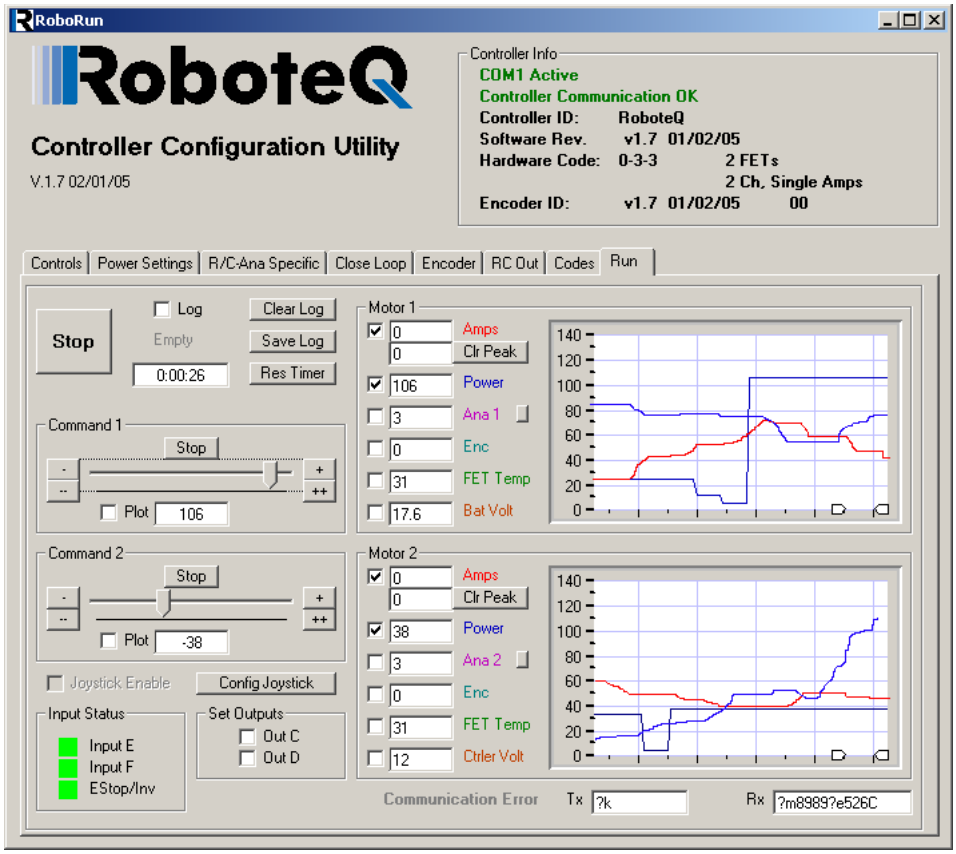


FIGURE 6. Roborun Utility screen layout

To connect the controller to your PC, use the provided cable. Connect the 15-pin connector to the controller. Connect the 9-pin connector to your PC's available port (typically COM1). Apply power to the controller to turn it on.

Load your CD or download the latest revision of Roborun software from www.Roboteq.com, install it on your PC and launch the program. The software will automatically establish communication with the controller, retrieve the software revision number and present a series of buttons and tabs to enable its various possibilities.

The intuitive Graphical User Interface will let you view and change any of the controller's parameters. The "Run" tab will present a number of buttons, dials and charts that are used for operating and monitoring the motors.

Obtaining the Controller's Software Revision Number

One of the unique features of the AX3500 is the ability to easily update the controller's operating software with new revisions downloaded from Roboteq's web site at www.roboteq.com. This is useful for adding features and/or improving existing ones.

Each software version is identified with a unique number. Obtaining this number can be done using the PC connection discussed previously.

It is also possible to get the controller to display the software version number by following these simple steps

- Disconnect the power from the motor batteries
- Press and hold the **Set** button while powering or resetting the controller

The LED will display a sequence of two numerical digits and an optional letter separated by dashes as shown in the examples below.

= Software version 1.7

FIGURE 7. Press and hold "Set" to display version number and enter self-test

After these digits are displayed, the controller will attempt to power the motors as part of the self test mode (see "Self-Test Mode" on page 47 of the User's Manual for a more detailed explanation). This is why the **motor's battery must be disconnected**. After about 30 seconds, the software revision number will be displayed every 30 seconds.

You will need to reset, or power down and up, the controller to exit and resume normal operations.

Now that you know your controller's software version number, you will be able to see if a new version is available for download and installation from Roboteq's web site, and which features have been added or improved.

Installing new software is a simple and secure procedure, fully described in "Operating the AX3500 over a Wired or Wireless LAN" on page 178 of the User's Manual.

Exploring further

By following this quick-start section, you should have managed to get your controller to operate in its basic modes within minutes of unpacking.

Each of the features mentioned thus far has numerous options which are discussed further in the complete User's Manual, including:

- Self test mode
- Emergency stop condition
- Joystick calibration
- Using Inputs/Outputs
- Current limiting
- Closed Loop Operation
- Software updating
- and much more